An assessment of resource conservation in WEEE management from a life cycle perspective: a case study of E-scrap recycling in Belgium

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Transition towards circular economy has been defined as a strategic action plan to promote a sustainable and resource efficient economy, especially for economies depending on import of raw materials like Europe. Accordingly, waste is considered as resource and waste disposal should be minimized. The waste hierarchy also defines recycling as a preferred option next to waste prevention and reuse to manage waste fractions containing high valuable contents like electronic scrap (E-scrap). However, recycling is not for free. Therefore, comprehensive and systematic assessment of the performance of E-scrap recycling is crucial to ensure the sustainability of the system.

In Belgium, after collecting the waste electrical and electronic equipment is separated into five fractions i.e., cooling and freezing appliances, big white goods, television screen and monitor, gas discharge lamp, and other appliance (so-called OVE), in which the OVE is the biggest fraction (39%). In this study, the performance of the recycling of the OVE fraction in 2013 was assessed. First, material flow analysis (MFA) was employed to assess the OVE recycling chain. Second, the Cumulative Exergy Extraction from the Natural Environment (CEENE) method was used to quantify the overall natural resource consumption of the recycling system in the life cycle perspective. The result is then compared with a benchmarking scenario, in which OVE fraction is incinerated and the same basket of product (BoP) is obtained from virgin materials. The results show that base metals such as ferrous, aluminum and copper are recycled at a large extent (more than 96%). Moreover, the recycling is mainly performed in Belgium (7%) and the rest of Europe (91%), and hence supporting the circulation of these materials within European economy. The exergetic life cycle assessment identified the secondary treatment (smelting, etc.) as the most resource demanding step of the whole recycling chain, representing over 96% of the total resource consumption. Nuclear energy and fossil fuels, caused by electricity consumption contributed most to the total resource footprint. Finally, in comparison with the landfill scenario, the natural resource consumption of the recycling scenario is 27% lower, indicating the higher sustainability from the resource perspective.